U. S. Department of Agr.
Forest Service
Relative humidity and
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July, 1923

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By

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Forest Examiner, Forest Service,
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FIRE is a natural phenomenon and is controlled by natural laws. Each season brings its variety of fire problems, but the natural laws remain constant. The complexity of problems is due to the lack of knowledge on our part of the laws that control the fire situation. We pass the invisible things and think that they are negligible in our everyday affairs of life. But the infinitely small is the infinitely powerful and the invisible water vapor in the air, which varies in quantity, both actually and relatively, is all-powerful in fire prevention and control. A deficiency in the quantity of water vapor brings about a most serious fire situation. On the other hand an accumulation of water vapor soon builds up a barrier that baffles the wildest raging fires and subdues them. The condition of the air with reference to the quantity of water vapor existing is known as humidity, and can be easily determined at any time by taking a reading with a small instrument consisting of two thermometers, known as a psychrometer.

Relative humidity is the percentage of saturation of the air, and largely governs its absorbing or evaporating power. Consequently the relative humidity is the greatest factor in controlling the moisture content of those forest materials (needles, fern moss, leaves, etc.) which are directly exposed to the air and determines the degree of their inflammability. The air absorbs moisture from this material when the humidity is low, or falling. The material absorbs moisture from the air when the humidity is high, or rising.

The inflammability of the forest materials is the most important factor which controls the fire hazard. Since relative humidity has a direct bearing on the degree of inflammability, and since this can be determined, a record of relative humidity therefore can be used as an indicator of the fire hazard.

The greatest fire hazard exists when the forest materials have dried to the point where the moisture content is less than that of their inflammability point. Under such conditions fires spread rapidly because the materials ahead of the fire ignite immediately without having to be dried out and advance fires are readily started by sparks. When highly inflammable forest materials such as dead fern, fireweed, moss or needles are exposed to the air the moisture content varies directly with the variations of relative humidity although the changes of the moisture content of the materials lag slightly behind the changes of relative humidity. Since the inflammability of those forest materials that are exposed to

the air, and which supply the fuel that feeds the rapidly spreading fires, can be determined by a record of the relative humidity the hourly, daily or periodic fluctations of the fire hazard can be recognized and can be predicted as far in advance as it is possible to predict the changes of relative humidity.

Extreme fire hazards are always a result of low relative humidity. Strong winds, steep slopes and intense heat from burning material are important factors which will naturally increase the rate of spread *after* the material has reached a certain degree of inflammability but regardless of wind, slope or heat any fire will very soon die down to, and remain in, the smoldering stage, or go out, if the relative humidity of the air becomes high.

Studies conducted by the Wind River Forest Experiment Station of the effect of relative humidity on forest fires showed that fires did not spread when the relative humidity was above 60 per cent. That they spread very slowly and only in very favorable material when the humidity was between 50 and 60 per cent. When the humidity was between 40 and 50 per cent fires picked up, varying from a few running fires to fires that merely smoked up and did not spread. With a humidity of 30 to 40 per cent fires gained some headway and some rapidly spreading fires occurred. A humidity below 30 per cent caused all fires that were in material that would allow spread at all to gain headway, or spread beyond control. Crown fires occurred when the humidity dropped to 25 per cent or lower.

INTERPRETATION OF RELATIVE HUMIDITY RECORDS.

The greatest aid in fire prevention is a knowledge of when critical conditions are developing and when extra precautionary measures are necessary. Such conditions are shown by the relative humidity records of the previous few hours or possibly days or nights. These indications afford an opportunity for preparing for any emergency that may arise as well as providing a plan of action on existing fires. The fluctuations of the inflammability of the forest materials has long been recognized, but the fact that these daily or periodic fluctuations were caused by the changes of relative humidity has not been known. The establishment of this definite relation of the relative humidity to the inflammability of the forest has thrown a new light on the whole field of forest fire prevention and control.

The smoldering fire changed into a raging conflagration within a few hours is not unfamiliar to those who have dealt with, and observed, forest fires. The fire that was beyond control one hour and quiet the next has likewise often been encountered. But how to know what the fire may be expected to do has always been left to conjecture. The discovery that these hourly or daily fluctuations of the fire are due to relative humidity furnishes a means of knowing why the fire varies so quickly and makes possible a determination of the possible condition of the fire

several hours or a day in advance. The relative humidity varies materially at different hours of the day and on different days and it is these variations primarily, which cause the changes in the fire hazard. It is the comparatively high humidity during the night that causes fires to quiet down or go out, and the comparatively low humidity during the heat of the day that makes them flare up within a few hours.

PERIODIC CONDITIONS DUE TO RELATIVE HUMIDITY.

A serious fire period and its development is shown graphically in figure 1. The unexpected and unprecedented conditions of May 28 to June 1, 1922, caused red letter fire days that will always stand out in the fire records of the Pacific Northwest because of the number of fires that occurred and their rapidity of spread.

The forerunner of this period is first recorded by the precipitous drop of the relative humidity beginning as early as 4 a. m. on May 27. At 8 a. m. the relative humidity had reached the dangerously low point of 21 per cent. Although the humidity dropped to 20 per cent it began rising again at 1 p. m., consequently the day of May 27, following a moist period, was not a serious fire day in itself. However the low humidity throughout the night of May 27 and May 28 followed by low humidity on the succeeding days and nights caused a period of drying that developed a grave fire situation. Rain, in varying amounts from a few hundredths inches to nearly an inch had occurred throughout the Pacific Northwest region during the period of May 21 to May 26 and there were no indications of a possible fire period. The forest floor was wet and smoldering fires were apparently harmless. Nevertheless all fires began picking up on May 28 and several developed into raging conflagrations within the day. Many other fires started within the period of low humidity and the greater number of them were destructive, uncontrollable fires. In fact during, this four day period in May, long before the normal opening of the fire season in this region, and immediately after heavy rains, there was probably more acreage burned over and greater damage sustained than during the entire balance of the season.

The period of low humidity continued until May 31 on the west side of the Cascade Mountains and until June 1 on the east side and each succeeding day made the conditions more hazardous. This extremely hazardous period however passed as quickly as it came and ended without rainfall. It was accompanied by an east wind, which is usually the case in this region, although periods of low humidity may occur accompanied by winds from any direction. Wind direction and temperature are given in figure 1 to illustrate the variations of these factors as compared to the relative humidity. The curves in figure 1 show that the temperature was not abnormally high during the period of low humidity and that the wind velocity was not high at any time and was lowest during some of the days of lowest humidity.

This period emphasizes the fact that rains make the forest safe from fire for only a short time if periods of low humidity occur. Also that serious fire conditions can develop within a single day but that a succession of days of low humidity is certain to cause an extremely hazardous situation. A large number of the fires that develop during such a period usually are due to smoldering fires, that have been neglected.

A critical fire period invariably goes down in history because of the enormous losses of timber, equipment, improvements and too often human lives, but a record of the climatic factors is not included. This same page of history will be continued just as long as the smoldering fire is a part of the accepted fire risk of the forest regions.

Unquestionably one of the main causes of our enormous fire losses has been due to the failure to realize how very suddenly forest materials may change from a low degree of inflammability to an extremely high degree of inflammability, and convert in a few hours, fires which have been smoldering harmlessly for days into raging conflagrations.

A realization of this situation can lead to only one conclusion, that the smoldering fires must be put out immediately while they are small, when they can be handled at small expense and before conditions change.

DAILY CONDITIONS DUE TO RELATIVE HUMIDITY.

The variations in relative humidity within the day are of paramount importance in fire control. A continuous record of humidity serves as an index to the atmospheric conditions. The possible conditions for the day are generally indicated by the humidity record as early as eight o'clock in the morning and extreme periods are often indicated earlier. The first index of the approach of a period of low humidity was recorded as early as 4 A. M. on May 27, 1922, and a record of 21 per cent at 8 A. M. indicated that the air was extremely dry. (see Figure 1) A record of low humidity in the early morning is due to a moisture deficiency in the atmosphere that generally extends over large areas.

The drying effect of a single day following a moist period, or rain, does not cause an extreme fire hazard although it may bring about local conditions that would cause fires to spread. This applies specifically to open, burned or cut-over areas. On the other hand a single day of low humidity following a period of drought causes an immediate fire hazard that may be general.

RELATIVE HUMIDITY AS AN INDEX OF FIRE HAZARD.

The fire situation caused by a period or even a day of low humidity will naturally vary somewhat with the general dryness of the forest. Low humidity is in itself dry air and consequently the inflammable ma-

terial of the forest is subjected to rapid drying conditions during the entire period of low humidity and the fire hazard increases in direct proportion to the length of the period. On the other hand during periods of high humidity the moisture content of the materials remains high and the fire hazard is low. In these respects relative humidity differs from temperature, wind velocity and other climatic factors. A high temperature may occur during periods of high humidity and consequently have no drying effect on the forest materials. However an extreme fire hazard will exist during periods of low temperature if the humidity is low. An increase in wind velocity does not necessarily increase the fire hazard because high winds often occur during periods of high humidity. On the other hand a high wind occurring during a period of low humidity causes the most serious combination of climatic factors. All of the great historic forest fires have occurred during days of extremely low relative humidity. In a few cases the wind was extremely high but in the great majority of cases the records show that the prevailing winds were not at all abnormal; and that in many cases the temperatures were even subnormal.

FIRE HAZARD DUE TO DAILY CHANGES OF HUMIDITY.

An example of the relation between daily and hourly changes in relative humidity and the fire hazard is given in Figure 2. On May 14, 1922, the moisture content in per cent, based on the dry weight of the materials at 110° F. and 10 per cent humidity, was determined throughout the day. Fern, firewood and pearly everlasting were used because they are the inflammable materials on which early spring fires spread in open areas. The immediate response in the moisture content of these materials in direct relation to the relative humidity is shown by the curves. The fern contained 112 per cent of moisture at 5 A. M. when the humidity was 87 per cent and at 8:15 A. M. it contained 20.8 per cent and had reached the inflammability point while the humidity had dropped to 38 per cent. From 8:15 A. M. until 6 P. M. the moisture content was below 20.8 per cent, consequently the fern was highly inflammable during this period and was extremely inflammable when the moisture content was as low as 11 per cent between 11 A. M. and 3 P. M. and the humidity was about 20 per cent. When the humidity began to rise at 3 P. M. the moisture content of the fern began to increase. At 6 P. M. the humidity had increased to 41 per cent and the moisture content of the fern had increased beyond the inflammability point of 20.8 per cent, consequently the fire day in fern areas ended at 6 P. M.

Although the moisture content and inflammability of fireweed and pearly everlasting varied from the fern, the moisture content of each material reached the inflammability point at practically the same time in the morning. The absorption of moisture by the fireweed and pearly everlasting in the evening, however, was slower than that of the fern

and the fire day in pearly everlasting did not end until about 7 P. M., and the fireweed was inflammable until after 9 P. M.

From these records it is evident that a period of humidity of 35 per cent or lower for only one day will cause a fire hazard in open areas of fern, fireweed, pearly everlasting and other weeds and grasses in the early spring before these dead materials are covered by a new growth of weeds, grasses and shrubs.

FLUCTUATIONS OF FIRE HAZARD AS RELATED TO RELATIVE HUMIDITY.

During the period of September 10 to 13, 1922, continuous readings of the moisture content of forest materials were taken and correlated with the relative humidity. More than 30 kinds of materials were included in this series but only two, the grey moss from Douglas fir trees and the needles and twigs of Douglas fir slash, cut in early spring and gathered in August, are used in the curves shown in figure 3, because they are two materials that are generally encountered in burning Douglas fir slash. The point of greatest importance in the fluctuation of the moisture content of these materials is the variation of time at which the inflammability line is crossed by different materials. On September 10 the moisture content of the moss passed above the inflammability point at 6 P. M. and the needles and twigs not until 2 A. M. On the morning of September 11 the needles and twigs were inflammable at 8:30 A. M. and the moss did not become inflammable until 10:30 A. M. The same relative position of inflammability of the materials was maintained each morning and evening. The consistent difference in time of inflammability of the different materials is the basis for determining when and how to burn slash or what methods to use in fire control.

APPLICATION OF RELATIVE HUMIDITY RECORDS TO PROTECTION AND SUPPRESSION WORK.

Definite knowledge in regard to the inflammability of forest materials as indicated by the relative humidity of the present moment, and reliable information in regard to the probable changes in burning conditions which will take place within the next few hours as interpreted from the trend of the relative humidity curve, are of inestimable value in all phases of protection and suppression work.

In connection with slash disposal it is a very dependable guide as to when slashings should be burned to obtain best results, as covered in detail under separate heading. It indicates when burning permits may be issued and when they should by all means be refused or even canceled.

In connection with logging operations it will enable the operator to vary the intensity of his protective measures in accordance with the existing hazard, instead of trusting entirely to one standard of protection for widely varying degrees of hazard.

This might well result in increasing the frequency of wetting down around donkey engines, in doubling or trebling the patrol on logging areas, for following locomotives, etc., for those short periods of only a few hours duration when the inflammability is known to be exceptionally high; and in very extreme cases, as might occur from one to four times a year, stopping all engines for a few hours until the critical period passes.

In connection with general fire protection work it is almost indispensible for securing a more intelligent and efficient utilization of our forces. Instead of relying on the widely varying physical senses or judgment of individuals of the organization which time and time again have failed to sense or realize the very sudden changes which often occur in the inflammability of the forest materials, we can depend absolutely on precise instruments for determining when it is comparatively safe to utilize a certain percentage of our protective organization on improvement work; when every protection man must be at his post and keyed up to the seriousness of the situation; when we should put on emergency patrols and lookouts and when for short periods we may wisely call on a portion of our improvement crews to stand by the phone or otherwise augment our protection forces. In connection with the initial and follow up action to be taken on any fire, this definite information should by all means be taken into account in determining the number of men to send in.

And finally in the actual fire fighting work frequent psychrometric readings will enable the fire chief to make much more accurate predictions, as to just what the fire is going to do on any particular sector for the next few hours than would otherwise be possible. For in any given type, on any given slope or under any given wind conditions the action of the fire will vary almost directly with the relative humidity conditions of the surrounding air, and for ascertaining this a psychrometer is infinitely more sensative than the perception of our most experienced fire fighters. Coupling this with the well known fact that success in fire suppression work hinges very largely on one's ability to know definitely what changes are going to take place in the condition of the fire before they occur emphasizes the vital importance of this knowledge. In the selection of methods it is extremely essential that we take into account not only the present condition of the fire on each sector but the changes which are bound to occur within the next few hours.

While ordinarily the direct method of attack is preferred whenever we can catch the fire in a smoldering stage or take advantage of stretches of front which have gone out, it is very essential that we know how long the fire will remain in this stage, when it will begin to pick up, when it will become too hot to work close, how much time we will have to complete a certain line, whether the fire will remain quiet for the balance of the day or be burning briskly at 10:00 A. M. or 2 P. M., etc.

In connection with the Parallel or Indirect Methods we must have the same information. Also we must know whether back fires can, or can not, be made to burn successfully now or within the next few hours; just when we can get the best results from backfiring. Whether the inflammability of the material is increasing or decreasing, whether conditions are such that sparks across the line are, or are not, apt to ignite

the material. We all know that on certain days or certain periods of the day thousands of sparks may fall across a line without establishing a single fire, while on another day or possibly only 2 or 3 hours later nearly every spark would ignite the material. We must know just as accurately as possible the very hours when the moss on the trees will not burn, when it can be safely burned off and when it is so inflammable that it would be sure to carry fire through the tops. In like manner, we must know as definitely as possible the exact periods when a patch of reproduction may, or may not, be depended upon to stop a running fire, when crown fires may occur in the heavy timber. These conditions are usually dependent upon both the degree of inflammability of the foliage and the intensity of the surface fires below, both of which are regulated by the humidity of the air. In like manner the intensity of our patrol, throughout the day and at night should by all means be varied and almost governed according to the marked changes in inflammability of the materials.

In short the answer to all of these questions may be had at any time through an intelligent interpretation of readings of the relative humidity as illustrated in Figures 2 and 3.

APPLICATION OF RELATIVE HUMIDITY RECORDS IN SLASH DISPOSAL.

Relative humidity is a reliable guide in determining the proper time to burn slash. Successful burning can be done during periods of high humidity, but burning would be dangerous and destructive during periors of low humidity. A high humidity protects the surrounding open areas of highly inflammable materials such as fern, grasses, fireweed, etc., and prevents the slash fires from causing crown fires in adjacent timber. Seed trees are also protected, because the moist air holds the heat of the fire at a lower level and consequently the crowns of the trees are not so readily burned out. Mature Douglas fir trees are usually not killed through the bark, but are killed by the heat of a slash fire rising through the crowns.

Generally the principal object in slash burning is to dispose of the debris and reduce the fire hazard on the area. However, there are other objectives to be obtained that are even more important, because the methods of slash disposal largely determine the future condition of the forest areas. Slash burning in the spring usually leaves the areas in more favorable condition for natural restocking, because the slash is dry enough to burn in the spring while the lower layers of duff still contain sufficient moisture to protect the seed that is stored in the forest floor from the heat of the fire. On the other hand, summer or fall slash fires that occur at a time when the forest floor is dry destroy the seed in the duff or soil and either prevent natural restocking of the areas or limit the restocking to seed trees or adjacent timber, which is a slow and uncertain process.

Restocking all cut-over areas, and thereby perpetuating the wonderful timber resource of the Pacific Northwest, depends almost entirely on

the two basic principles of proper slash disposal and adequate protection from fire after the young stands are established. Young growth soon covers the soil and reduces the fire hazard to a minimum, while open areas of weeds, grasses, and shrubs are the breeders of our worst conflagrations.

USE OF INSTRUMENTS.

The Hygro-thermograph

This instrument (see Plate I) consists of two independent, self-recording mechanisms, and an eight-day clock movement inclosed within a brass cylinder, upon which is placed an engraved sheet, or chart, for recording Relative Humidity and Air Temperature. The vertical cylinder revolves on its axis once in seven days, so that a continuous automatic record is obtained for an entire week.

The pen which records the Relative Humidity is controlled by strands of specially prepared hairs which expand or contract as the relative humidity of the air increases or decreases.

The record, being given directly in per cent, ranges from 0 to 100, or from absolute dryness to complete saturation of the air. The pen which records the temperature directly in degrees Fahrenheit is actuated by a silvered thermometric bulb to which a system of levers is attached.

The records of both the Relative Humidity and the Air Temperature as shown in Figures 1-3 are reproductions of charts made by this instrument.

The distinct advantages of the instrument are:

1. That the Relative Humidity is given directly in percentage, so that no tables are needed.

2. That the record is continuous, so that one may see at any time not only what the Relative Humidity is at the present moment, but also just how it has been fluctuating for the past several hours or days, the hourly duration of low extremes, and the present trend of the curve, all of which have a bearing on the present inflammability and are of very material assistance in making predictions for the next few hours or even days.

3. The addition of a continuous record of temperature, while not essential for determining present inflammability, is of assistance in predicting the probable course of the relative humidity curve.

This instrument as illustrated, with a year supply of sheets and detailed instructions for setting up, costs about $140.

A similar instrument known as a Hygrograph, which records the relative humidity only, can be obtained at a cost of about $98.00.

Sling Psychrometers.

The sling psychrometer is an extremely simple instrument consisting of just two thermometers mounted on a metal back which is provided

with a swivel handle for whirling. The bulb of one thermometer projects slightly below the other and is covered with a small piece of gauze for wetting. This is known as the wet bulb thermometer, and the other as the dry bulb thermometer.

To operate the instrument, moisten the gauze on the wet bulb thermometer with clear water, whirl the instrument for 15 or 20 seconds, then note the temperature recorded by both the wet and the dry bulb thermometers. Then without rewetting the gauze continue whirling for 5- or 10-second periods until certain that you have obtained the minimum reading of the wet thermometer.

Now substract the minimum reading of the wet bulb thermometer from the reading of the dry bulb thermometer and refer to the psychrometric tables, which are supplied with the instrument, when the Relative Humidity will be found in the line corresponding to the temperature of the dry bulb thermometer and the column corresponding to thhe difference in readings between the wet and dry bulb thermometers.

For example, assume that the reading of the dry bulb thermometer is 94 degrees and of the wet bulb 74 degrees. The difference is 20 degrees, and the relative humidity of the air is 39 degrees, as shown in the line 94 and the column 20 of the small psychrometric table geven below. If the dry bulb thermometer gives a reading of 80 degrees and the wet bulb 70 degrees, the relative humidity will be 61 degrees.

RELATIVE HUMIDITY TABLES.

Temperature Readings in Degrees Fahrenheit. Relative Humidity Readings in Per Cent. Barometric Pressure 29.0 inches.

Readings of Dry Bulb Thermometer	Difference in Degree Fahrenheit between wet and dry bulb thermometer																			
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
80	76	72	68	64	61	57	54	51	47	44	41	38	35	32	29	27	24	21	18	16
82	76	72	69	65	62	58	55	52	49	46	43	40	37	34	31	28	25	23	20	18
84	77	73	70	66	63	59	56	53	50	47	44	41	38	35	32	30	27	25	22	20
86	77	74	70	67	63	60	57	54	51	48	45	42	39	37	34	31	29	26	24	21
88	78	74	71	67	64	61	58	55	52	49	46	43	41	38	35	33	30	28	25	23
90	78	75	71	68	65	62	59	56	53	50	47	44	42	39	37	34	32	29	27	24
92	78	75	72	69	65	62	59	57	54	51	48	45	43	40	38	35	33	30	28	26
94	79	75	72	69	66	63	60	57	54	52	49	46	44	41	39	36	34	32	29	27
96	79	76	73	70	67	64	61	58	55	53	50	47	45	42	40	37	35	33	31	29
98	79	76	73	70	67	64	61	59	56	53	51	48	46	43	41	39	37	34	32	30

More complete tables than those furnished with the instruments, and which provide for differences in barometric pressure or elevation are contained in "Weather Bureau Bulletin No. 235, by C. V. Marvin," which can be obtained from the Superintendent of Public Documents, Washington, D. C., at 10 cents a copy.

Simply stated the principle on which the sling pschrometer works is that evaporation is a cooling process and the decrease in the temperature of the wet bulb thermometer is directly proportional to the rate of evaporation, from the moistened gauze, which in turn is directly proportional to the dryness or absorbing power of the surrounding air through which the instrument is swung.

Special care should be taken to insure a minimum reading of the wet bulb thermomter; if the instrument is not whirled long enough, it will be too high; while if it is whirled too long, the gauze will dry so that thhe temperature will have reached the minimum and have begun to rise again. By whirling the psychrometer several times for short periods, the lowest point is easily found.

Ordinarily the psychrometer should be whirled under conditions corresponding as nearly as possible in regard to shade, temperature, etc., as exist on the particular area for which the information is desired.

If the psychrometer is whirled in the sun it should always be shaded while being read, for when the instrument is not being whirled the direct rays of the sun will quickly raise it to a temperature considerably higher than that of the air.

Care must be taken. to keep the muslin on the wet bulb clean Handling it with sweaty hands will soon decrease its capacity to absorb water and result in incorrect readings.

Great care must be exercised in handling and whirling the psychrometers, as the exposed bulbs are very easily broken.

Certain advantages of the sling psychrometers over other instruments are that they are they are very accurate, have no mechanism to get out of order, are portable for field use, and comparatively inexpensive.

The two types of psychrometers illustrated in plate 2 are exactly the same in principle.

No. 1322 is approximately 17" long, has a pivoted handle for whirling, and is provided with and open-face copper case. It is considered especially well adapted for use about headquarters stations.

No. 1323 is approximately 7" long and is provided with a steel-lined leather case which makes it particularly well adapted for use in the field or on the fire line.

The cost of these instruments when purchased through the U. S. Forest Service or the Western Forestry and Conservation Association, Portland, Oregon, is approximately

No. 1322------------------$ 8.75 each

No. 1323------------------$10.00 each

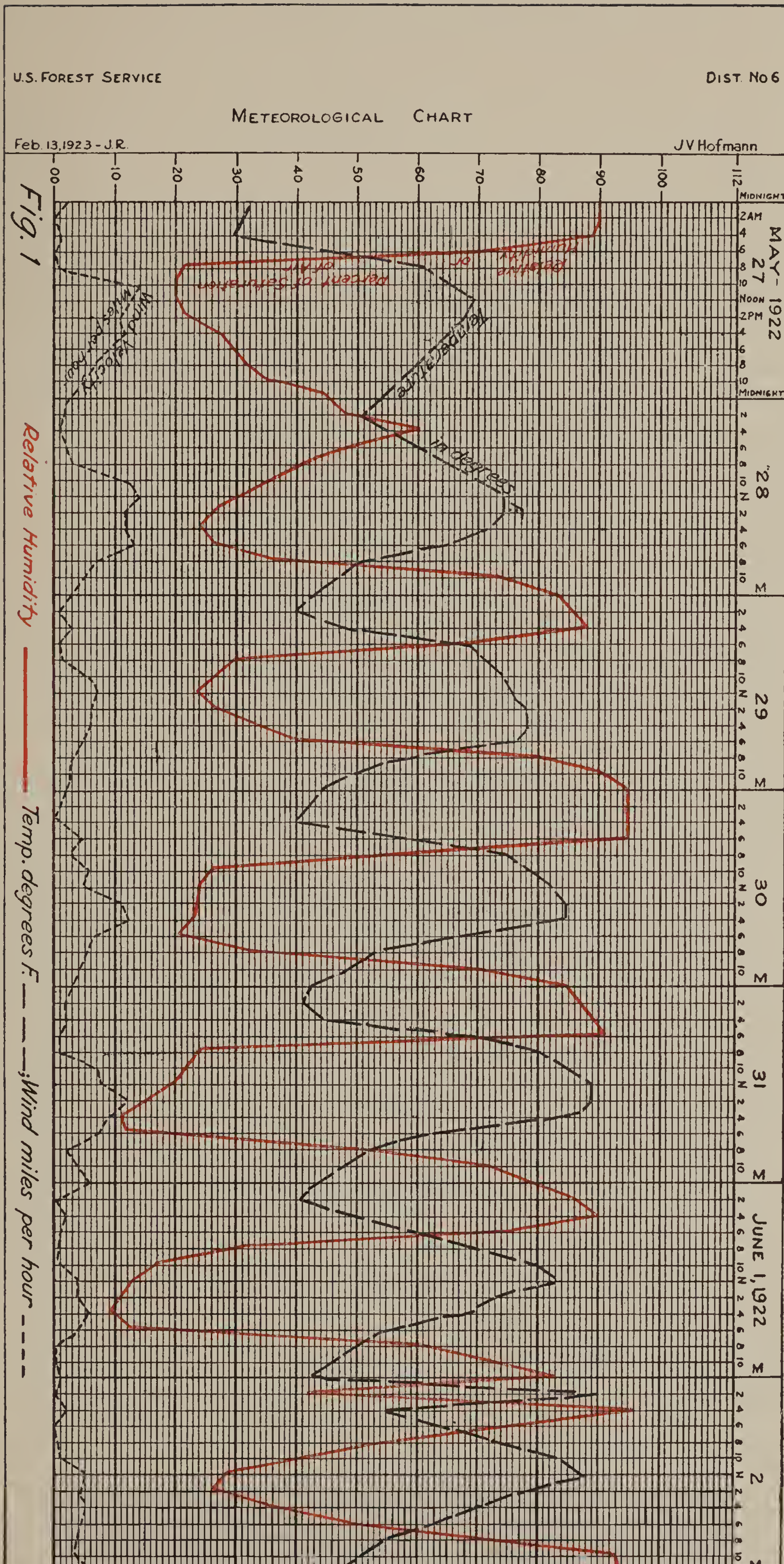

U.S. FOREST SERVICE
DIST. No 6
METEOROLOGICAL CHART
Feb. 13, 1923 - J.R.
J V Hofmann
MAY - 1922
JUNE 1, 1922
Relative Humidity
Temp. degrees F.
Wind miles per hour

Fig. 1

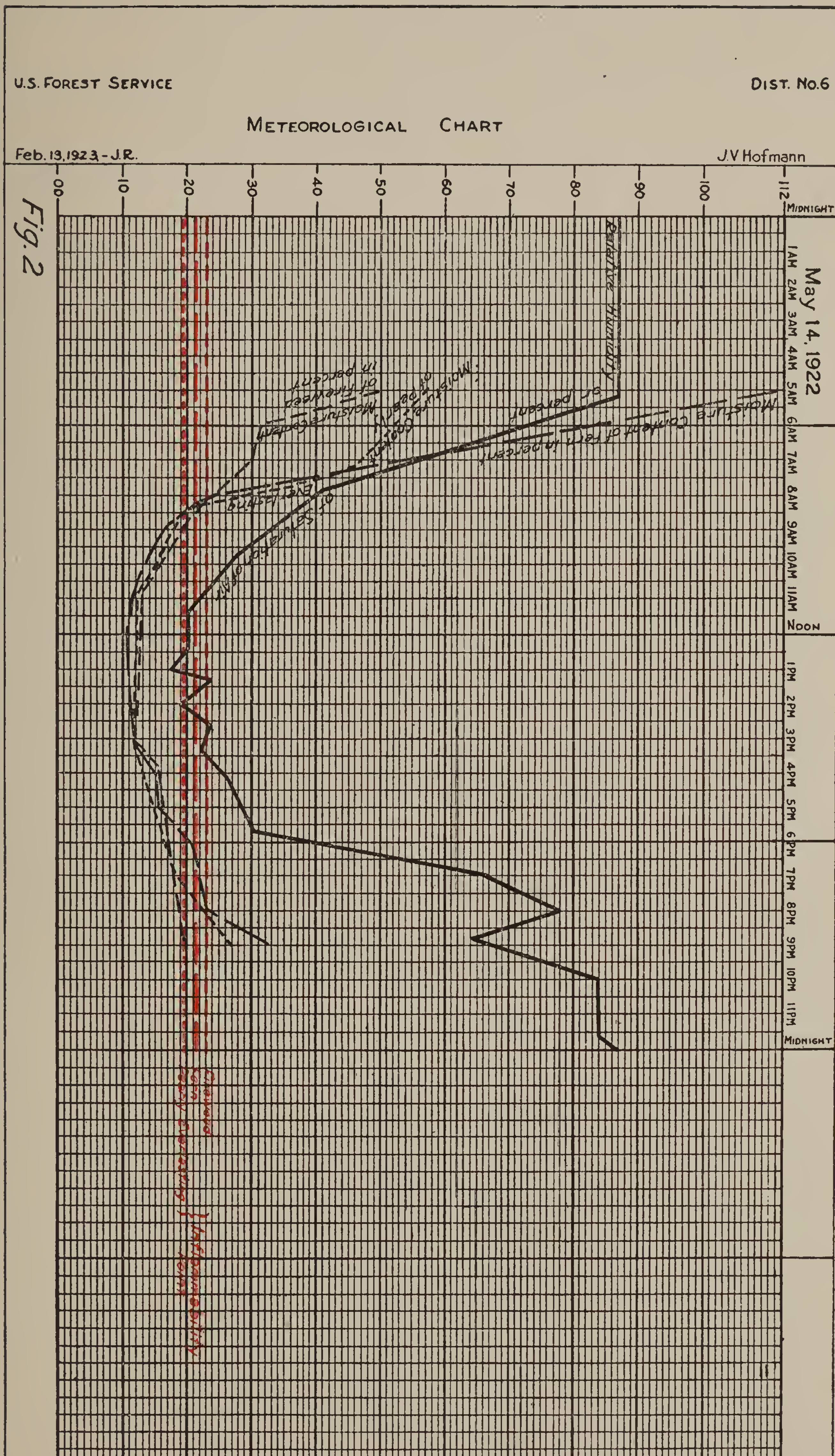
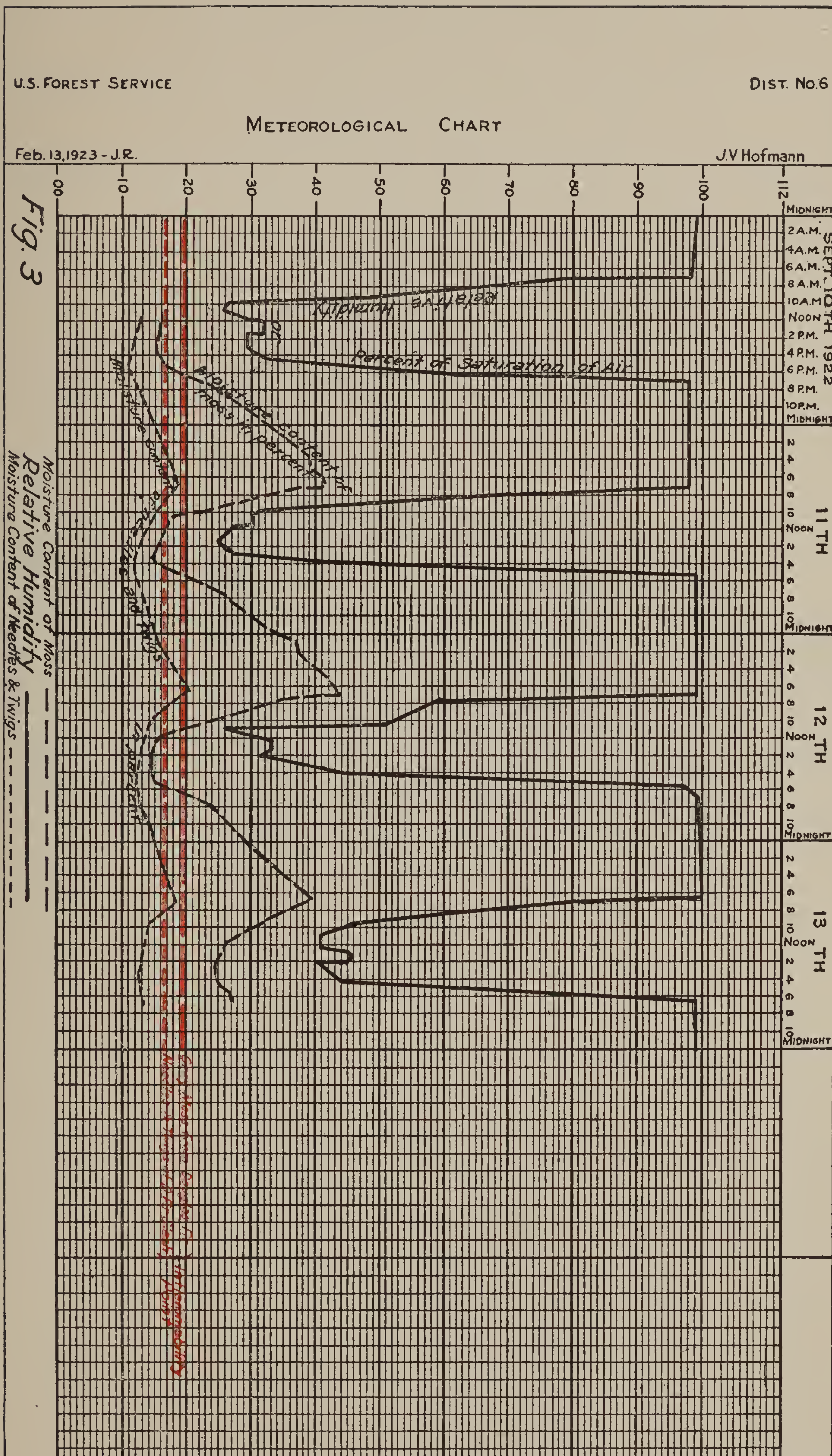

U.S. Forest Service
Dist. No.6
Meteorological Chart
Feb. 13, 1923 - J.R.
J.V Hofmann
May 14. 1922
Midnight
1AM 2AM 3AM 4AM 5AM 6AM 7AM 8AM 9AM 10AM 11AM
Noon
1PM 2PM 3PM 4PM 5PM 6PM 7PM 8PM 9PM 10PM 11PM
Midnight
00 10 20 30 40 50 60 70 80 90 100 112
Relative Humidity in percent
Moisture content of fern in percent

Fig. 2


U.S. Forest Service
Dist. No.6
Meteorological Chart
Feb. 13,1923 - J.R.
J.V Hofmann
00
10
20
30
40
50
60
70
80
90
100
112
Midnight
2 A.M.
4 A.M.
6 A.M.
8 A.M.
10 A.M.
Noon
2 P.M.
4 P.M.
6 P.M.
8 P.M.
10 P.M.
Midnight
Sept. 10th 1922
11 th
12 th
13 th
Relative Humidity
Percent of Saturation of Air
Moisture content of moss in percent
Moisture content of needles and twigs in percent
Moisture Content of Moss
Relative Humidity
Moisture Content of Needles & Twigs
Fig. 3

Hygro-Thermograph

(Or Combined Hygrograph and Thermograph)

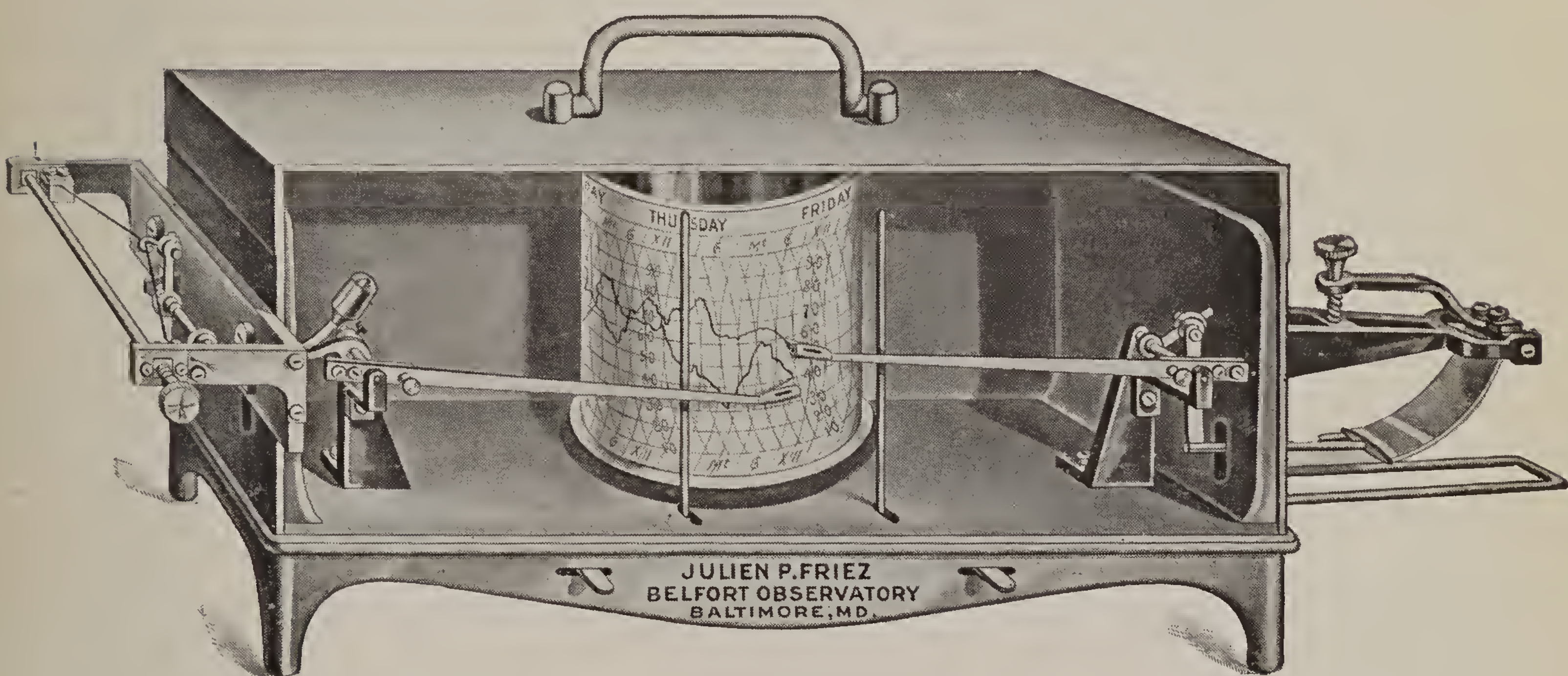
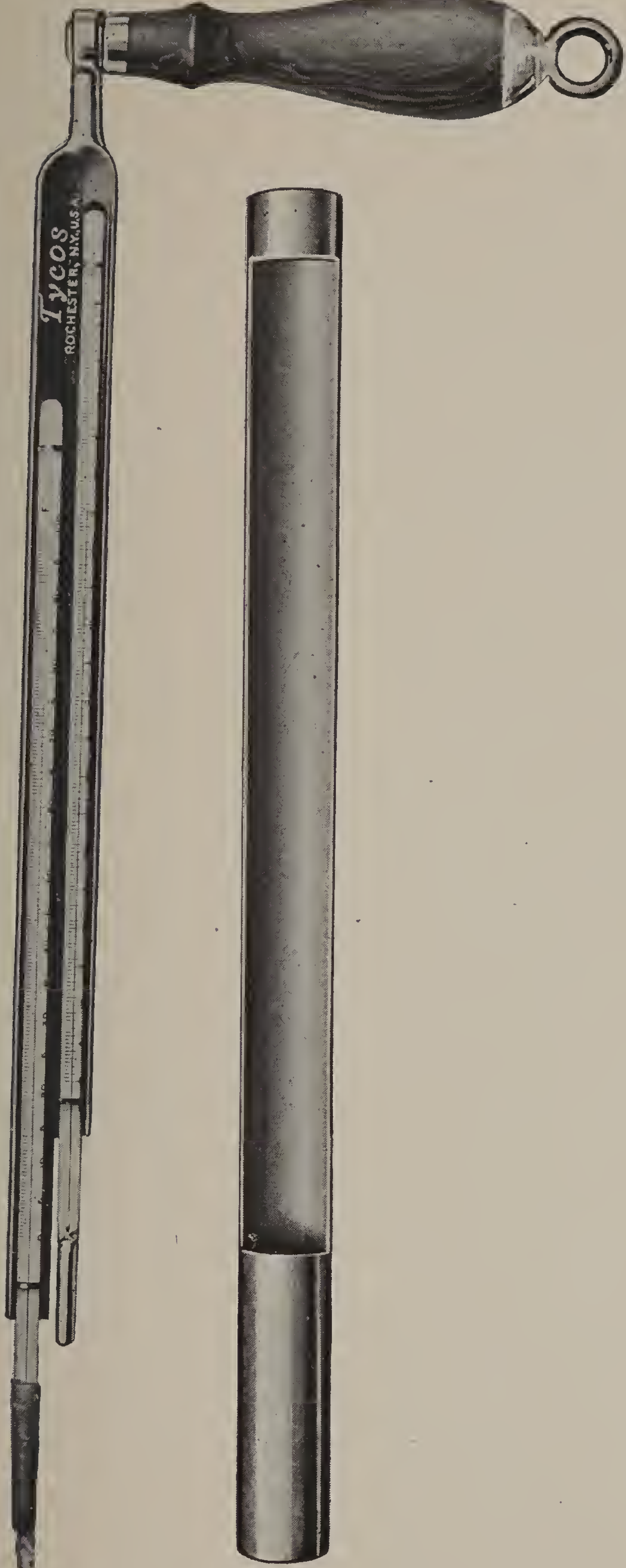


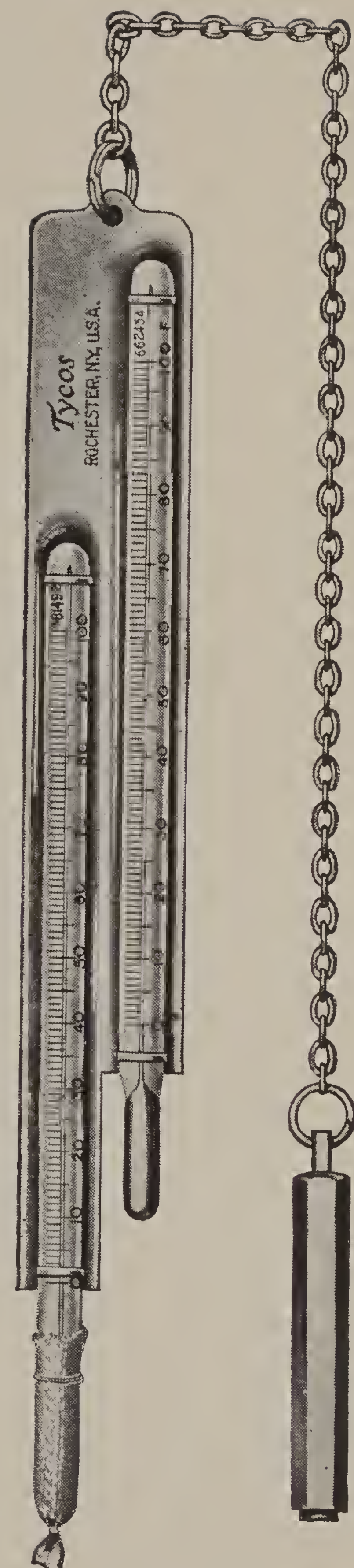
PLATE 1

JULIEN P. FRIEZ & SONS
MANUFACTURERS
BELFORT METEOROLOGICAL OBSERVATORY
BALTIMORE, MD.



No. 1322

Sling Psychrometer



No. 1323

Pocket Sling Psychrometer

PLATE No. 2